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(54) **A hearing instrument with directional microphones**

Hörgerät mit Richtmikrofonen

Prothèse auditive avec des microphones directionnels

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Description

[0001] The field of the invention concerns hearing instruments, and particularly hearing instruments with directional microphones.

[0002] Conventional hearing instruments typically comprise a single omni-directional microphone, which amplifies sound substantially equally from all directions. Because of the omni-directional nature of these hearing instruments, it is often difficult for the wearer to distinguish between a speaker's voice and background noise. Hearing instruments have therefore been developed that accentuate a speaker's voice over background noise.

[0003] Directional microphones may be implemented in hearing aids in several ways. In one system, two or more omni-directional elements are linked to two or more individual ports. One microphone is linked to each port, and electrical signals are processed in order to extract the directional response. Alternatively, one or more directional elements may be linked to two or more ports. One directional microphone is linked to two ports, and the signal is processed by the directional element as is known from WO 00/38477. The difference in sound intensity on the closely-positioned ports of this type of directional hearing aids is typically negligible and the information about the direction of arriving sound signals is derived from the phase differences of the sound signals.

[0004] However, directional microphones, although suitable for isolating a speaker's voice, typically have signal-to-noise ratios less than that of omni-directional microphones. Also, directional microphones are very sensitive to wind noise. Thus, in environments with little background or high wind noise, an omni-directional microphone is more desirable for use in processing sound. Therefore, hearing instruments have been developed that include both an omni-directional and a directional microphone, wherein a wearer switches between the two modes as desired.

[0005] Unfortunately, hearing instruments that contain both an omni-directional microphone and a directional microphone typically have lower sensitivity in the directional mode and are larger in size as compared to hearing instruments containing only an omni-directional microphone. These dual mode hearing instruments generally have two separate microphone cartridges and a separate toggle switch for switching between them. The total space occupied by these components limits their use to users with ears large enough to accommodate the devices. An unfortunate result is that children often cannot make use of these larger devices.

[0006] Accordingly, the hearing instrument industry seeks reduced sized hearing instruments with improved sensitivity and simplified assembly, yet having the advantages of both omni-directional and directional functionality.

[0007] The invention is defined in the independent claims, to which reference should now be made. Advantageous sub-features are defined in the dependent claims.

[0008] Embodiments of the invention include a hearing instrument for positioning in the ear of a user, incorporating a faceplate having first and second spatially separated sound openings for receiving sound to be provided to respective inlets of a microphone; at least one screen partially blocking the sound openings and positioned to increase effective distance between the first and second spatially separated sound openings; and a housing for containing the microphone representing the received sound, the housing having the faceplate mounted thereon, the housing being sized to fit within the ear of a hearing instrument wearer and containing the microphone.

[0009] Preferred features of the present invention will now be described, purely by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a drawing illustrating a cross-sectional view of a preferred embodiment of a microphone section of a hearing instrument;
Figure 2 is a drawing illustrating a top view of a preferred embodiment of a microphone component;
Figure 3 is another drawing illustrating a cross-sectional view of a preferred embodiment of a hearing instrument; and
Figure 4 is a picture illustrating a preferred embodiment of a hearing instrument.

[0010] The invention will be understood more fully from the detailed description given below and from the accompanying drawings of preferred embodiments of the invention; which, however, should not be taken to limit the invention to a specific embodiment but are for explanation and understanding.

[0011] A hearing instrument in accordance with a preferred embodiment of the invention includes a microphone component having directional and omni-directional functionality. The directional cartridge is preferably assembled with the omni-directional cartridge (as a single entity). For example, there may be a single microphone with directional and omni-directional functionality, comprising two abutting cartridges. Alternatively the directional and omni-directional functionality may be referred to as two microphones. A gasket, preferably made of a pressure-sensitive adhesive, may be used to achieve sealing and acoustic leak prevention in the device. One or more windscreens are also used to partially block two sound openings of the hearing instrument to increase the effective distance between these two sound openings, which provides for a higher sensitivity in the directional mode.

[0012] Figure 1 depicts a cross-sectional view of a hearing instrument device according to one preferred embodiment of the invention. A microphone component 102 may be at least partially embedded in a faceplate 104. In an exemplary embodiment, microphone component 102 is in cartridge form. Inlets to microphone com-

ponent 102 may be included on a microphone component surface 106, as further described in connection with Figure 2. The illustrative example depicted in Figure I has surface 106 perpendicular to the plane of the page. Surface 106, however, may be any surface of microphone component 102 on which the inlets may be positioned.

[0013] A front port 108 and a rear port 110 may be positioned in faceplate 104 to allow sound to travel to the microphone component inlets. (The terms "front" and "rear" are used herein to facilitate understanding of the invention. The terms, however, do not limit the invention to particular relative configurations, and are merely used for illustration.) The distance between the front and rear ports is preferably in a range of about 5mm to about 12mm, although not limited thereto.

[0014] One or more screens, commonly known as windscreens are provided for the ports. A screen may cover both, or a single port. Windscreens 116 and/or 118 may thus be included for ports 110 and 108. Windscreens 116 and 118 preferably extend across ports 110 and 108 and the microphone component inlets. Windscreens 116 and 118 may contain holes 112 and 114 (e.g., perforations) and partially obstruct the ports, therefore increasing the effective distance between ports 108 and 110. For example, they may obstruct the portions of the ports closest to each other. The windscreens may also be used in hearing instruments employing a single-element directional microphone with a mechanical switch.

[0015] The windscreens may be placed/configured at a relative angle to reduce the size and improve the external contour of the hearing instrument.

[0016] Figure 2 depicts an exemplary microphone component that may be used in preferred embodiments of the invention. Microphone component 102 may include a first microphone cartridge 126, which is preferably located directly adjacent a second microphone cartridge 128 (here along surface 130). In a preferred embodiment, first microphone cartridge 126 may be an omni-directional microphone cartridge, for example, and second microphone cartridge 128 may comprise a directional cartridge. First microphone cartridge 126 preferably includes a front, omni-directional, inlet 132, while second microphone cartridge 128 preferably includes a rear, directional, inlet 134, and a front, directional, inlet 136. Rear inlet 134 preferably further includes an acoustic resistor 138, such as acoustic mesh, through which sound travels. The cross-sectional area of front inlet 136 is preferably in a range of about 0.05mm^2 to about 2.0mm^2, although not limited thereto.

[0017] Microphone component 102 preferably further includes gasket 122, which may be used to seal surface 106 of microphone component 102 within the hearing instrument. This helps to minimize acoustical leaks from the device. Gasket 122 preferably comprises a pressure sensitive adhesive, but is not limited thereto.

[0018] Inlets 132, 134, and 136 are preferably located on the same face of the microphone component (e.g., surface 106). Locating them on the same face of the assembly may be advantageous by reducing device size, and improving directionality, sensitivity and signal-to-noise ratio and simplification of the assembly procedure. Sensitivity improvements resulting from the operation and configuration of the inventive hearing instrument device are estimated to be in the range of at least about 1-4 dB.

[0019] Embodiments of the invention may be used for various types of hearing instrument devices, for example, in the ear (ITE), in the canal (ITC), half shell (HS), and behind the ear (BTE) devices. Various circuit types may also be used with the inventive hearing instrument device, including, for example, analog and digital circuits.

[0020] Figure 3 further depicts a hearing instrument device according to a preferred embodiment of the invention. An electric circuit 140 is operatively connected to the microphone component 102. The electronic circuitry processes an electrical signal from the microphone component representing the received sound. Microphone component 102 is operatively connected to an electrical switch assembly 120 through electric circuit 140, so that the microphone component can be switched between directional mode and omni-directional mode. A receiver 142 is operatively connected to electric circuit 140 to generate an acoustical signal in the user's ear based upon the received sound. A housing 144 preferably surrounds microphone component 102, electric circuit 140 and receiver 142. Faceplate 104 may be mounted on housing 144 to accommodate microphone component 102. Housing 144 may be sized to fit within the ear of a hearing instrument user. The housing may also be configured to be compatible with ITC, HS, and BTE use.

[0021] Figure 4 is a picture illustrating a preferred embodiment of a hearing instrument 150. Faceplate 104 is preferably rounded and cosmetically shaped for insertion into the ear. The position of microphone component 102 behind faceplate 104 is illustrated by dashed lines. Ports 108 and 110 may be seen, located behind screens 118 and 116, respectively. Toggle switch 124 of switch assembly 120 for switching between omni-directional and directional modes is located on the outside of faceplate 104 for access by the user. A volume control 146 may be further included to control the sensitivity of the hearing instrument. For example, volume control 146 may comprise a user tunable potentiometer, operatively connected to electric circuit 140 and/or receiver 142 for control the flow of electric current therein.

[0022] While the invention has been described by illustrative embodiments, additional advantages and modifications will occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to specific details shown and described herein. Modifications, for example, to the layout of the hearing instrument device components and their spacing, may be made without departing from the scope of the invention as defined by the claims. Accordingly, it is intended that the invention not be limited to the specific illustrative embodiments,

but be interpreted within the full scope of the appended claims.

Claims

1. A hearing instrument for positioning in the ear of a user comprising:

   a faceplate (104) having first and second spatially separated sound openings (108, 110) for receiving sound to be provided to respective inlets of a microphone; and
   at least one screen (116, 118) partially blocking said first and second spatially separated sound openings and positioned to increase effective distance between said first and second spatially separated sound openings.

2. A hearing instrument according to claim 1 further comprising a housing (144) for containing said microphone and electronic circuitry for processing a signal from said microphone representing said received sound, said housing having said faceplate mounted thereon, said housing being sized to fit within the ear of a hearing instrument wearer.

3. A hearing instrument according to claim 2, wherein

   the microphone comprises a directional microphone and an omni-directional microphone;
   the faceplate (104) has first and second spatially separated sound openings for receiving sound channeled to respective inlets of said directional microphone, sound received via said first and second spatially separated sound opening also being channeled to an inlet of said omni-directional microphone; and wherein
   the housing (144) having said faceplate mounted thereon contains said omni-directional microphone, said directional microphone and electronic circuitry coupled to said microphones for processing a sound representative signal, said directional microphone inlets and said omni-directional microphone inlet being located on the same surface.

4. A hearing instrument according to Claim 3, including a gasket (122) for acoustically isolating said inlets of said directional microphone and said omni-directional microphone.

5. A hearing instrument according to Claim 3 or 4, including a switch (124) for selecting between an output generated by said directional microphone and an output generated by said omni-directional microphone.

6. A hearing instrument according to claim 1 or 2 comprising:

   a front port (108) in said faceplate for receiving sound therethrough; and
   a rear port (110) in said faceplate spatially separated from said front port for receiving sound therethrough;
   the at least one screen (116, 118) substantially covering said front port and said rear port ;
   the microphone receiving said sound through said front port and said rear port, the microphone comprising an omni-directional component and a directional component adjacent each other.

7. A hearing instrument according to claims 1 or 2, wherein said microphone comprises a plurality of microphone components.

8. A hearing instrument according to any of claims 3 to 5 or to claim 7, further comprising an electric circuit and receiver within said housing (144) for receiving electrical signals from said directional microphone and/or said omni-directional microphone and producing an acoustical signal based on said sound.

9. A hearing instrument to according to Claim 6, further comprising an electric circuit and receiver within said housing (144) for receiving electrical signals from said directional microphone component and/or said omni-directional microphone component and producing an acoustical signal based on said sound.

10. A hearing instrument according to Claim 8 or 9, further comprising a volume control for controlling the intensity of said acoustical signal.

11. A hearing instrument according to any of the Claims 6, 9 or 10, wherein said microphone is mounted to said faceplate with a gasket (122) comprising a pressure-sensitive adhesive to substantially seal said microphone within said faceplate to prevent acoustic leaks.

12. A hearing instrument according to any of the preceding claims, wherein said screen (116, 118) contains a plurality of holes (112, 114) for admitting sound.

13. A hearing instrument according to any of the preceding claims, wherein said screen is placed at a relative angle to the microphone inlets for improved cosmetics of the hearing aid and reduced size.

14. A hearing instrument according to Claim 6 or any claim dependent thereon wherein said omni-directional component and said directional component include a plurality of inlets for receiving said sound, said plurality of inlets being located on a same face

of said microphone to reduce the size of said hearing instrument and improve directionality, sensitivity and signal-to-noise ratio of said hearing instrument.

15. A hearing instrument according to Claim 4, wherein said gasket (122) comprises a pressure-sensitive adhesive to substantially seal said microphone within said faceplate to prevent acoustic leaks.

Patentansprüche

1. Hörgerät für die Positionierung im Ohr eines Benutzers, aufweisend:

   eine Blende (104) mit ersten und zweiten räumlich getrennten Schallöffnungen (108, 110), um Schall aufzunehmen, der jeweiligen Eingängen eines Mikrophons zuzuführen ist; und
   mindestens eine Abschirmung (116, 118), welche teilweise die ersten und zweiten räumlich getrennten Schallöffnungen blockiert und so positioniert ist, dass sie den effektiven Abstand zwischen den ersten und zweiten räumlich getrennten Schallöffnungen vergrößert.

2. Hörgerät nach Anspruch 1, weiter aufweisend ein Gehäuse (144) zum Halten des Mirkophons und einer elektronischen Schaltung zum Verarbeiten eines Signals von dem Mikrophon, welches den empfangenen Schall repräsentiert, wobei die Blende auf das Gehäuse montiert ist, wobei die Größe des Gehäuses so ist, dass es in das Ohr eines Trägers des Hörgeräts passt.

3. Hörgerät nach Anspruch 2, wobei

   das Mikrophon ein gerichtetes Mikrophon und ein ungerichtetes Mirkophon umfasst;
   die Blende (104) erste und zweite räumlich getrennte Schallöffnungen zum Empfang von Schall aufweist, welcher in jeweilige Eingänge des gerichteten Mikrophons gelenkt wird, wobei der Schall, welcher über die ersten und zweiten räumlich getrennten Schallöffnungen empfangen wird, auch zu einem Einlass des ungerichteten Mirkophons gelenkt wird; und wobei
   das Gehäuse (144) mit der darauf aufgebrachten Blende das ungerichtete Mikrophon, das gerichtete Mikrophon und die elektronische Schaltung, die an die Mikrophone gekoppelt ist, um ein für den Schall repräsentatives Signal zu verarbeiten, enthält, wobei die gerichteten Mikrophoneingänge und der ungerichtete Mikrophoneingang auf derselben Oberfläche gelegen sind.

4. Hörgerät nach Anspruch 3, aufweisend eine Dichtung (122) zum akustischen Isolieren der Eingänge des gerichteten Mikrophons und des ungerichteten Mikrophons.

5. Hörgerät nach Anspruch 3 oder 4, umfassend einen Schalter (124) zur Auswahl zwischen einem Ausgang, der von dem gerichteten Mikrophon erzeugt wird, und einem Ausgang, der von dem ungerichteten Mikrophon erzeugt wird.

6. Hörgerät nach Anspruch 1 oder 2, aufweisend:

   eine vordere Mündung (108) in der Blende zum Empfang von Schall durch diese; und
   eine rückwärtige Mündung (110) in der Blende, welche räumlich von der vorderen Mündung getrennt ist, für den Empfang von Schall durch diese;
   die mindestens eine Abschirmung (116, 118), welche im Wesentlichen die vordere Mündung und die rückwärtige Mündung bedeckt;

   wobei das Mikrophon den Schall durch die vordere Mündung und die rückwärtige Mündung empfängt, wobei das Mirkophon eine ungerichtete Komponente und eine gerichtete Komponente enthält, die einander benachbart sind.

7. Hörgerät nach Anspruch 1 oder 2, wobei das Mikrophon eine Anzahl an Mikrophonkomponenten enthält.

8. Hörgerät nach einem der Ansprüche 3 bis 5 oder nach Anspruch 7, weiter aufweisend eine elektrische Schaltung und einen Empfänger innerhalb des Gehäuses (144) zum Empfang von elektrischen Signalen von dem gerichteten Mikrophon und/oder dem ungerichteten Mikrophon und zum Erzeugen eines akustischen Signals basierend auf dem Schall.

9. Hörgerät nach Anspruch 6, weiter aufweisend eine elektrische Schaltung und einen Empfänger innerhalb des Gehäuses (144) zum Empfang von elektrischen Signalen von der gerichteten Mikrophonkomponente und/oder der ungerichteten Mikrophonkomponente und zum Erzeugen eines akustischen Signals basierend auf dem Schall.

10. Hörgerät nach Anspruch 8 oder 9, weiter aufweisend eine Lautstärkensteuerung zum Steuern der Intensität des akustischen Signals.

11. Hörgerät nach einem der Ansprüche 6, 9 oder 10, wobei das Mikrophon auf der Blende mit einer Dichtung (122) angebracht ist, welche einen druckempfindlichen Klebstoff umfasst, um das Mikrophon im Wesentlichen mit der Blende zu versiegeln, um akustische Lecks zu verhindern.

12. Hörgerät nach einem der vorstehenden Ansprüche, wobei die Abschirmung (116, 118) eine Anzahl an Löchern (112, 114) zum Einlass von Schall enthält.

13. Hörgerät nach einem der vorstehenden Ansprüche, wobei die Abschirmung unter einem relativen Winkel zu den Mikrophoneingängen zur verbesserten Kosmetik des Hörgeräts und für eine verringerte Größe angeordnet ist.

14. Hörgerät nach Anspruch 6 oder einem darauf rückbezogenen Anspruch, wobei die ungerichtete Komponente und die gerichtete Komponente eine Anzahl an Eingängen zum Empfang des Schalls aufweisen, wobei die Anzahl an Eingängen auf derselben Seite des Mikrophons gelegen sind, um die Größe des Hörgeräts zu verringern und um die Gerichtetheit, die Empfindlichkeit und das Signal-/Rauschverhältnis des Hörgeräts zu verbessern.

15. Hörgerät nach Anspruch 4, wobei die Dichtung (122) einen druckempfindlichen Klebstoff aufweist, um das Mikrophon innerhalb der Blende im Wesentlichen abzudichten, um akustische Lecks zu verhindern.

Revendications

1. Une prothèse auditive pour mise en place dans l'oreille d'un utilisateur comprenant :

   une plaque de surface (104) comprenant de première et seconde ouvertures acoustiques séparées spatialement (108, 110) pour recevoir des sons devant être fournis aux entrées respectives d'un microphone ; et
   au moins un écran (116, 118) bloquant partiellement lesdites première et seconde ouvertures acoustiques séparées spatialement et mis en place pour augmenter la distance effective entre lesdites première et seconde ouvertures acoustiques séparées spatialement.

2. Une prothèse auditive selon la revendication 1 comprenant en outre un boîtier (144) pour contenir ledit microphone et des circuits électroniques pour traiter un signal issu dudit microphone et représentant lesdits sons reçus, ledit boîtier comprenant ladite plaque de surface montée dessus, ledit boîtier étant dimensionné pour s'adapter à l'intérieur de l'oreille d'un porteur de la prothèse auditive.

3. Une prothèse auditive selon la revendication 2, dans laquelle

   le microphone comprend un microphone directionnel et un microphone omnidirectionnel ;
   la plaque de surface (104) comprend de première et seconde ouvertures acoustiques séparées spatialement pour recevoir des sons canalisés vers les entrées respectives dudit microphone directionnel, les sons reçus par l'intermédiaire desdits première et seconde ouvertures acoustiques séparées spatialement étant également canalisés vers une entrée dudit microphone omnidirectionnel ; et où
   le boîtier (144) présentant ladite plaque de surface montée dessus contient ledit microphone omnidirectionnel, ledit microphone directionnel et les circuits électroniques couplés auxdits microphones pour traiter un signal représentatif des sons, lesdites entrées du microphone directionnelle et ladite entrée du microphone omnidirectionnelle étant situées sur la même surface.

4. Une prothèse auditive selon la revendication 3, comprenant une garniture (122) pour isoler acoustiquement lesdites entrées dudit microphone directionnel et dudit microphone omnidirectionnel.

5. Une prothèse auditive selon la revendication 3 ou 4, comprenant un commutateur (124) pour sélectionner entre une sortie produite par ledit microphone directionnel et une sortie produite par ledit microphone omnidirectionnel.

6. Une prothèse auditive selon la revendication 1 ou 2, comprenant :

   un orifice antérieur (108) dans ladite plaque de surface pour recevoir des sons à travers lui ; et
   un orifice postérieur (110) dans ladite plaque de surface séparé spatialement dudit orifice antérieur pour recevoir des sons à travers lui ;
   cet au moins un écran (116, 118) recouvrant sensiblement ledit orifice antérieur et ledit orifice postérieur ;
   le microphone recevant lesdits sons à travers ledit orifice antérieur et ledit orifice postérieur, le microphone comprenant un composant omnidirectionnel et un composant directionnel près l'un de l'autre.

7. Une prothèse auditive selon la revendication 1 ou 2, dans laquelle ledit microphone comprend une pluralité de composants de microphone.

8. Une prothèse auditive selon l'une quelconque des revendications 1 à 3 ou selon la revendication 7, comprenant en outre un circuit électrique et un récepteur à l'intérieur dudit boîtier (144) pour recevoir des signaux électriques issus dudit microphone directionnel et/ou dudit microphone omnidirectionnel et produire un signal acoustique basé sur lesdits sons.

9. Une prothèse auditive selon la revendication 6, comprenant en outre un circuit électrique et un récepteur à l'intérieur dudit boîtier (144) pour recevoir des signaux électriques issus dudit composant de microphone directionnel et/ou dudit composant de microphone omnidirectionnel et produire un signal acoustique basé sur lesdits sons.

10. Une prothèse auditive selon la revendication 8 ou 9, comprenant en outre une commande de volume pour régler l'intensité dudit signal acoustique.

11. Une prothèse auditive selon l'une quelconque des revendications 6, 9 ou 10, dans laquelle ledit microphone est monté sur ladite plaque de surface avec une garniture (122) comprenant un adhésif sensible à la pression afin de rendre sensiblement étanche ledit microphone à l'intérieur de ladite plaque de surface pour empêcher des fuites acoustiques.

12. Une prothèse auditive selon l'une quelconque des revendications précédentes, dans laquelle ledit écran (116, 118) contient une pluralité de trous (112, 114) pour l'admission de sons.

13. Une prothèse auditive selon l'une quelconque des revendications précédentes, dans laquelle ledit écran est placé selon un angle relatif par rapport aux entrées du microphone pour une amélioration de la cosmétique de l'aide auditive et une réduction des dimensions.

14. Une prothèse auditive selon la revendication 6 ou l'une quelconque des revendications qui en dépende dans laquelle ledit composant omnidirectionnel et ledit composant directionnel comprennent une pluralité d'entrées pour recevoir lesdits sons, ladite pluralité d'entrée étant située sur une même surface dudit microphone afin de réduire les dimensions de ladite prothèse auditive et améliorer le caractère directionnel, la sensibilité et le rapport signal sur bruit de ladite prothèse auditive.

15. Une prothèse auditive selon la revendication 4, dans laquelle ladite garniture (122) comprend un adhésif sensible à la pression pour rendre sensiblement étanche ledit microphone à l'intérieur de la plaque de surface afin d'empêcher des fuites acoustiques.

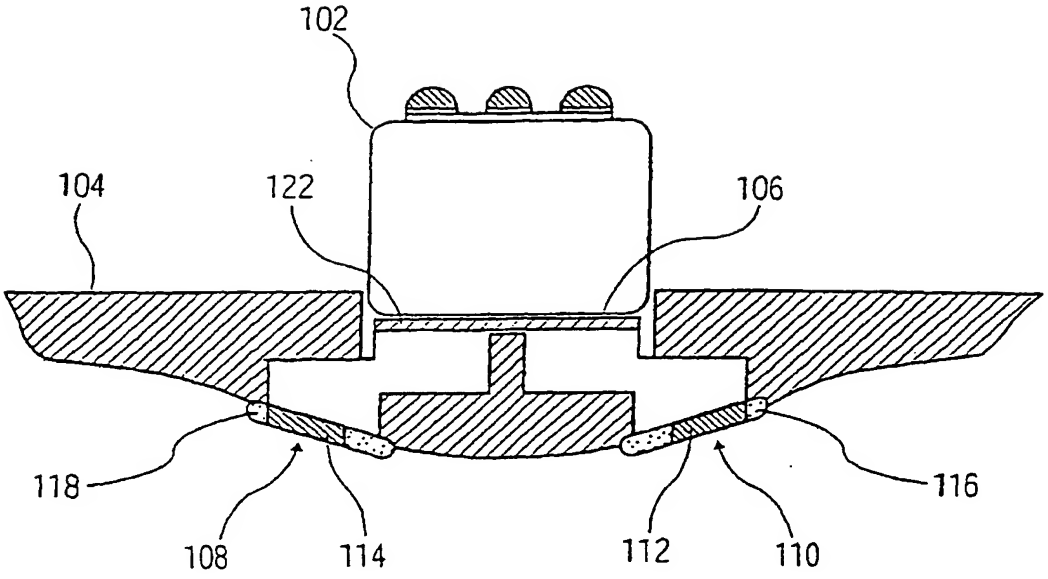
102
104
122
106
118
116
108
114
112
110

FIG. 1

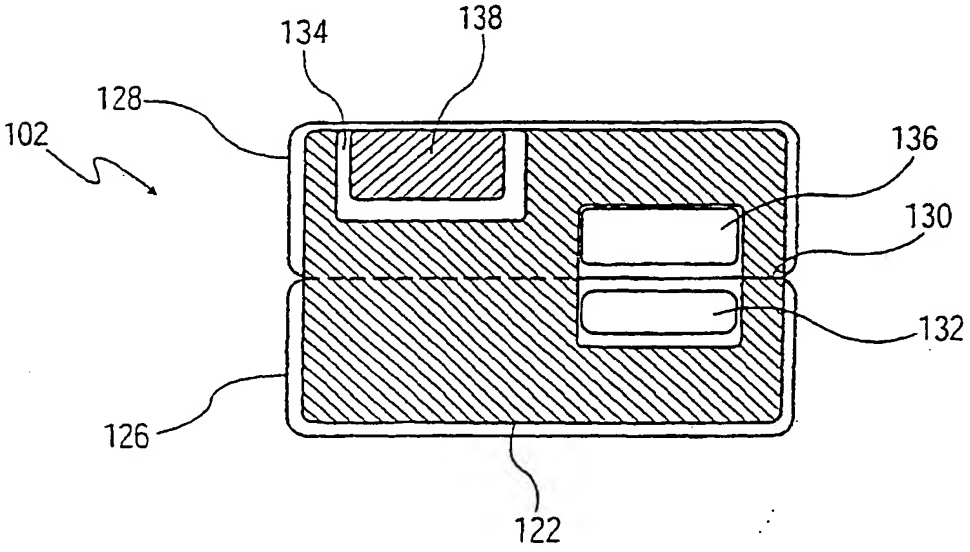
134
138
128
102
136
130
132
126
122

FIG. 2

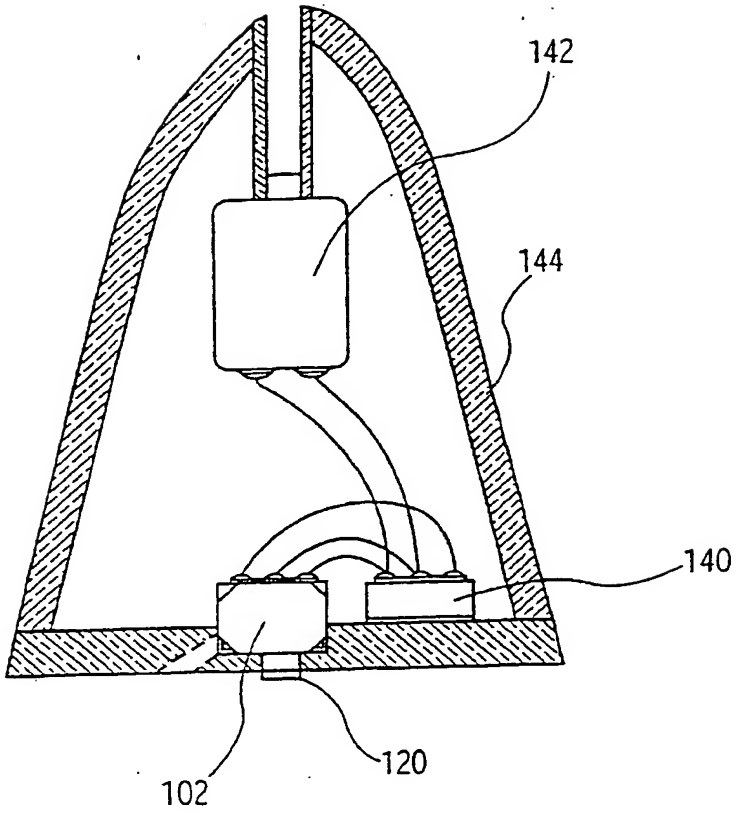

FIG. 3

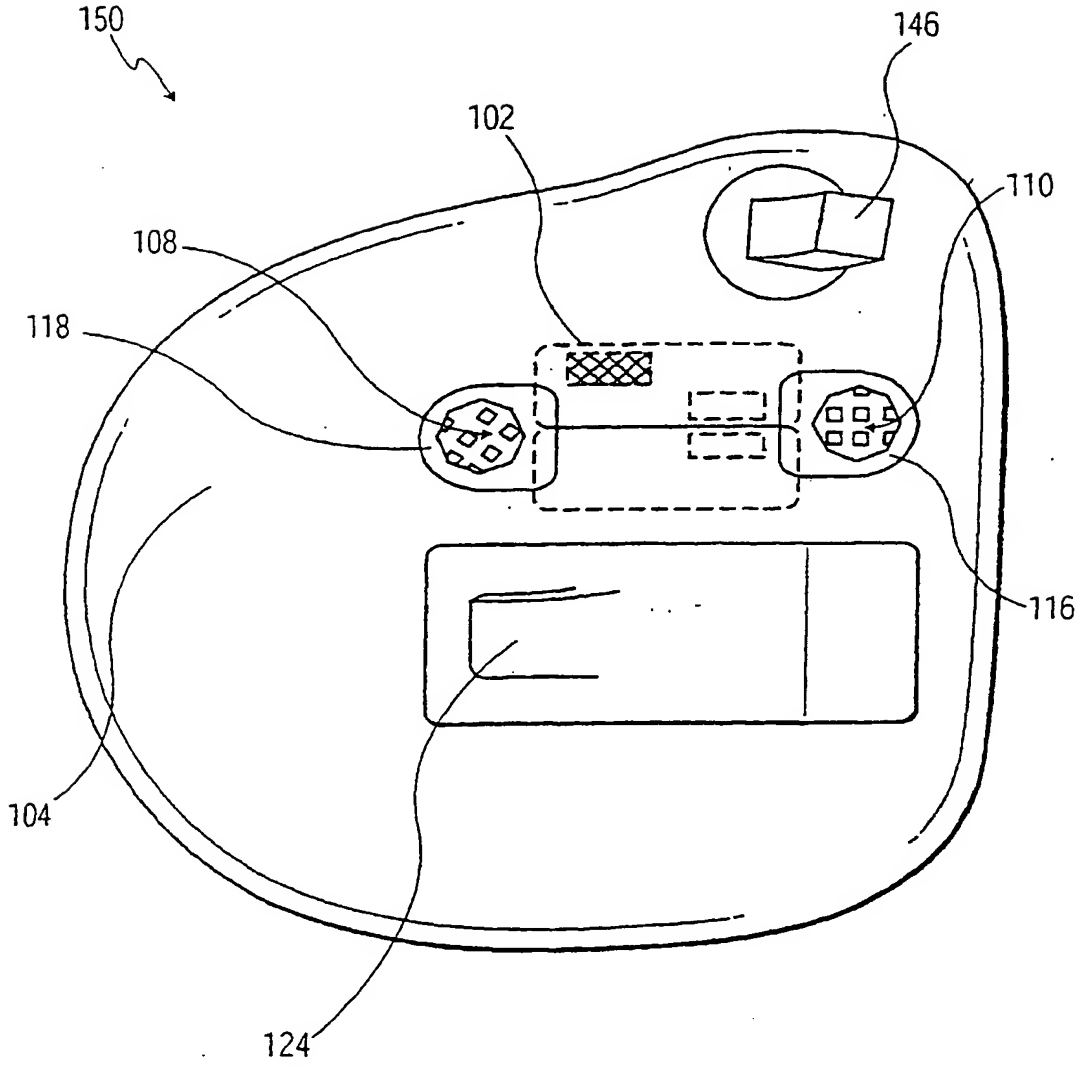

FIG. 4